

COMPUTER HARDWARE INC.

LDA FUNCTION TEST  
OPERATOR'S GUIDE

KA:4070  
F/N: 213698

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CHI

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## LARGE DISC ADAPTER FUNCTION TEST OPERATOR'S GUIDE

KA4070 F/N 213648

Title - Large disc Adapter Function Test  
PID - 0511  
Version - 00  
Mod Level - 00  
Date - 05/09/78  
F/N - 213696 (Source Listing) 213697 (Card Deck)  
P/N - KA4068 (Source Listing) KA4069 (Card Deck)

1.0

## INTRODUCTION

This diagnostic software tests and verifies the proper operation of the Large Disc Adapter and its associated drive. It tests most possible combinations of normal, diagnostic, fault and error conditions in a sequence of thirty standard routines. A listing of and a description of each routine's operation appears later. There are also three optional routines which support test functions not normally needed to verify the basic operation of the LDA.

1.1

The routines are designed so that each tests a single aspect of the operation of the adapter or drive and does not use any function which has not previously been tested by another routine. The routines are in an approximately graduated order from the least complex to that of greatest complexity.

1.2

The function test also has a number of optionally used commands which may allow one to more easily track down a failure condition such as: "Execute the last command in error and loop" or; "Perform diagnostic sense in case of error", etc., in addition to the standard functions supported by the diagnostic monitor.

1.3

The LDA Function Test operates under the control of the CHI diagnostic monitor and all functions are supported. Please refer to the diagnostic monitor documentation (F/N 213405). Note the way in which the monitor functions are supported in the following paragraphs.

2.0

## PREREQUISITES

2.1

## Hardware:

2.1.1

CHI 2130, 2120, or 3230 CPU with a minimum of 16K of memory.

2.1.2

Large Disc Adapter with one or more drive(s) connected to it.

2.1.3

1442 or 2501 or equivalent card reader wired for IPL.

2.1.4

A disc pack with at least one full cylinder which is not defective and which contains no data which are not erasable and thus lost forever by this test.



2.2 Software:  
2.2.1 Relocating loader F/N 213406, or 213407  
2.2.2 Diagnostic monitor F/N 213405  
2.2.3 LDA Function Test F/N 213697

3.0 **LOADING**

The LDA Function Test operates under the control of the CHI diagnostic monitor. Most standard procedures apply. For a complete description of the monitor and its myriad functions please refer to document F/N 213405.

- 3.1 First place the CHI relocating loader deck for your particular card reader F/N 213406 (1442) F/N 213407 (2501) into the card reader's hopper. Follow that with the diagnostic monitor, mentioned above. Above the monitor (affectionately nick-named "diabolic monster" at the CHI test facility) you may load up to fifteen test programs designed to run on it.
- 3.2 Before pressing the familiar sequence of front panel buttons: "IMMEDIATE STOP"; "RESET"; "PROGRAM LOAD" respectively, put data switch 15 up to halt after loading. Put it off (down) if you wish to have the program begin running immediately. Also, be certain that the card reader is ready and has not timed-out as you were reading this.
- 3.3 A complete, numbered, step by step loading sequence follows:
  - 3.3.1. CPU, drive, card reader power on.
  2. CPU data, lamptest and interrupt disable switches: all off. Write storage protect bits and check stop: on. Run mode rotary switch: run.
  3. If CPU has solid state memory hold clear storage in while momentarily pressing start to clear the memory.
  4. Insert disc pack to be utilized into the drive to be tested.
  5. Press "NPRO" on the 1442 reader with all old cards removed.
  6. Put the following card decks in the card reader's hopper in the order specified:
    - A. Relocating Loader (F/N 213406:1442, F/N 213407:2101
    - B. Diagnostic Monitor
    - C. LDAFT
    - D. Other tests
    - E. With the 1442, place 1 blank card at the end
    - F. Card weight
  7. Press "IMMEDIATE STOP"
  8. Set data switch 15 on: to halt the monitor programs after loading (to allow other entries to be made) or off to load and go.
  9. Place the disc drive start switch in the "start" position to start the drive.



10. Ready the card reader.
11. Press "IMMEDIATE STOP" followed by "RESET" and "PROG LOAD".
12. If loading fails check the card reader and be certain that the CPU (solid state) memory was cleared per item #3.

3.4 It is suggested that until you are familiar with this diagnostic you run it without overlapping other routines, that you halt it upon loading and that it be started with "log test routines" (SW9) on. (Enter / $\emptyset$ 1C0)

3.5 CHECK LIST

1. POWER ON
2. CLEAR STORAGE
3. CORRECT PACK IN CORRECT DRIVE
4. LOAD: R. LOADER / D. MONITOR / LDAFT / OTHER TESTS /
5. CR READY: IMM STOP, RESET, IPL
6. DATA SWITCH 15 (ON = STOP OFF = GO)
7. ENTER COMMANDS AND START TEST

4.0

## ROUTINES IN THE LDA FUNCTION TEST

1. NO-OPERATION WITH OP-END AND PROGRAMMED INTERRUPT TEST
2. NO-OPERATION WITH SENSE DEVICE STATUS WORDS (DSW)
3. SENSE DSW WITH MASK/UNMASK OF INTERRUPT
4. DIAGNOSTIC SENSE TEST (SENSE 256 BYTES OF "SCRATCH-PAD" RAM)
5. SELECT/DESELECT DRIVE(S) TEST
6. HEAD SET TEST
7. SEQUENTIAL SEEK TEST
8. MAXIMUM MINIMUM SEEK TEST
9. ABSOLUTE RANDOM SEEK TEST
10. UNAVAILABLE CYLINDER TEST
11. READ SECTOR ID'S TEST
12. INITIALIZE WRITE (ID) TEST
13. WRITE VARIOUS DATA FIELDS TEST
14. READ INCREASING WORD COUNT TO EIGHT SECTORS
15. WRITE/READ RANDOM DATA FIELDS AND COMPARE THEM
16. TEST SUPPRESS TRANSFER FUNCTION
17. TEST THE ALTERNATE SECTOR AND TRACK FUNCTION
18. UNAVAILABLE HEAD TEST
19. UNAVAILABLE SECTOR TEST
20. DIAGNOSTIC READ TEST
21. DIAGNOSTIC WRITE TEST
22. READ ID AND DATA TEST
23. TEST OFFSET SEEKS
24. CHAINED COMMAND BUFFER TEST
25. CREATE DATA COMPARE ERROR AND TEST
26. CREATE NO-SYNC ERROR AND TEST
27. READ ONLY SECTOR TEST
28. CREATE DATA ERRORS AND TEST ECC RECOVERY
29. WRITE/READ ENTIRE CPU MEMORY
30. PERFORM RANDOM WRITES/READS AT RANDOM CYLINDERS AND HEADS 1
31. TEST SECTOR/HEAD/CYLINDER AUTOMATIC OVERFLOW FOR MULTIPLE SECTOR OPERATIONS 3
32. QUICK INITIALIZE ROUTINE (DOES NOT ASSIGN ALTERNATES) 2 3
33. READ ALL SECTOR ID'S AND DATA TO VERIFY 3

<sup>0</sup> This test not performed on "System" 80 Megabyte Packs (2 cylinders required)

<sup>1</sup> This test only executes "Reads" on System Packs

<sup>2</sup> This test is not executed on System Packs

<sup>3</sup> These routines are optionally selected



5.0

## OPERATION OF THE DIAGNOSTIC

The standard monitor switches apply to this software and are implemented as follows: (Function Ø)

5.1

MONITOR SWITCH (ERLCK) /ØØXX

PROGRAM SWITCH (ZERO) /Ø1XX (LDAFT as first program)

"XX" Refers to bits 8-15 as follows:

BIT 8: START/RESTART PROGRAM(S)  
BIT 9: LOG TEST ROUTINES  
BIT 10: LOOP ON CURRENT X10  
BIT 11: LOOP ON PROGRAM  
BIT 12: LOOP ON ERROR  
BIT 13: SUPPRESS CONSOLE OUTPUT  
BIT 14: HALT ON ERROR  
BIT 15: HALT PROGRAM

5.2

Note that with the diagnostic monitor all switch entries are followed by pressing "Console Interrupt:. Bits 4-7 refer to the program in load sequence order, zero naturally being the monitor.

5.3

Of the four high-order bits Ø-3 only Ø and 1 are used. This allows for four general types of switch-entered commands. We have defined the zero setting for these bits. For running under default conditions with no special routine or option selection, no other switch-related instructions need be utilized. Special functions 1-3 are covered in paragraphs that follow.

5.4

Note that the selection for bit 10 varies somewhat from the monitor. "Loop on Last X10" is supported. The last X10 issued to the disc adapter will be repeated until the program is told otherwise. This is often helpful in certain error situations where a tight loop is necessary. (Loop-on-current-routine is more easily supported by Function 0 SW11, loop-on-program, and "Function One" for the particular routine in question)

5.5

After successfully loading the program, the following message will be printed on the console:

A0000	NUM	PID	ADRS	RELF	LD
XXXX	XXXX	XXXX	XXXX		

## 5.5 (cont.)

Under "NUM" will be the loading sequence number of the program. Under "PID" the program's identifier. Under "ADRS" the starting address of the program. Under "RELF" will be found the relocation factor for the program.

5.6 To start the LDAFT the first time enter /01C0 in the switches. Press console interrupt. The program will require that you enter the Drive Number upon which the test is to be run and whether or not the pack to be used for the test is a System Pack.

5.7 The first question is self-evident. The second function can restrict the operation (YES) of the test to a single cylinder on the pack. The default cylinder for this operation is /326. To vary the standard OP cylinder, see program options. TSO does not now utilize cylinder /326 on the LDA.

5.8 To restrict the test, enter /C118. To allow the test to write outside the standard cylinder (/326) enter /C119.

5.9 The test will now begin to run (SW8) and log test routines (SW9). Any errors encountered in the operation of the drive will be logged.

5.10 This program utilizes XR4, XR5 and XR6 to display operating information to the user. XR4 displays, in decimal (BCD format) the current routine number. XR5 contains the current cylinder value (HEX) and XR6 contains the head value in bits 0-7 (HEX) and the current sector value in bits 8-15 (HEX) to the best of the program's knowledge. Note that if other programs are running in overlap with this program, these registers may be violated by the other program(s). Please note that routine 29 uses XR4 as a flag and therefore "29" will not be displayed for this routine.

5.11 Since Routine 29 writes and reads the entire CPU memory up to 64K, if an LDA failure occurs in it's operation the entire program and monitor may be "wiped out". The result of this occurance may be an "OP CHECK" and an unusable program.

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## MESSAGE FORMAT

6.1 All messages are in the format as described under the Diagnostic Monitor. All console output may be suppressed by the setting of "SUPPRESS CONSOLE OUTPUT" switch in section 4.1. (Enter /0104)

The messages and errors are in the following form:

APPNN OORR AAAA Message

or

EPPNN OORR AAAA Message

where

A denotes a status message

E denotes an error message

PP is the PID of the routine requesting the message. This will either be 11 for LDAFT or 00 for the monitor.

NN is the message identifier

RR is the routine in execution

AAAA is the starting address of the routine.

Any abnormal or error conditions are logged by the LDAFT. Of particular interest is the format for Read/Write errors, enumerated below.

6.2

### Read/Write Error Messages

Whenever an unexpected error occurs on a read or write operation, a special error log format is employed. The message includes whether the error was hard or soft and whether a read or write thus: (Example)

6.3

### DATA COMPARE ERROR

SOFT READ ERROR:

WD1:-WD5:-WD6: LAST COMMAND CHAIN:

4800 1080 0000 8240 0326 120E 047F-23B5

6.4

In the example given above, first the significant DSW error is identified - "DATA COMPARE ERROR". This indicates that the sector ID was not correctly read on the first try (the other bit present, "SECTOR ID OK", is not significant as an error and is therefore not normally logged)

6.5

The second item identified is that the error is "soft", the LDA control code - internal to the adapter - was able to recover from the error. The error occurred on a read from the disc to host.



6.6 Under "WD1:-WD5:-WD6:-" are listed the contents of the LDA status words one, five and six. the most significant status information is contained therein.

6.7 Finally, the last read or write command chain generated by the program which resulted in the error presented is shown below the heading: "LAST COMMAND CHAIN:"  
additionally, if the error is hard, the entire first eight words of the DSW are logged.

## 7.0 PROGRAM TERMINATION

7.1 When the program terminates normally - then the routine selected (Function One) or the last sequencing routine (Routine 30) has just completed itself. If neither loop-on-program nor loop-on-current-XIO (SW10) are on and no error loops, halts or other functions have occurred, termination of the (SW11) program will then occur automatically.

7.2 To immediately and abnormally terminate the program without a summary listing one may enter /0101 or, of course, press "STOP" or "IMMEDIATE STOP" on the CPU's front panel.

7.4 When any normal program termination occurs a summary is printed on the console screen. There are a total of 26 basic counters and twenty eight HARD/SOFT counters which are accumulated by the LDAFT. However, only non-zero counters are logged by the summary routine.

7.5 When a basic counter has a Hard and Soft corresponding counter, it will be logged in the following manner: (example)

TOTAL HARD SOFT NUMBER OF READS:  
XXXX XXXX XXXX

7.6 Where the value below "TOTAL" refers to the total number of successful and unsuccessful operations. The value corresponding to "HARD" refers to those operations from which the LDA control code could not recover. Of course "SOFT" refers to the number of errors from which the LDA control code successfully recovered.



8.0

## MONITOR ERROR WAIT TABLE

B-REG	DESCRIPTION	ACTION
30BD	Read destroyed program	RELOAD
30F1	Checksum on loader	RELOAD
30F2	DSW error in load	RELOAD
30F3	Card 2 didn't load	RELOAD
30F4	Can't clear core	RELOAD
30F5	Send check while loading	RELOAD
30F6	Monitor didn't load	RELOAD
30F7	Checksum on monitor	RELOAD
30F8	Reader not READY	Make card reader ready
30F9	Invalid Interrupt did did not reset	RESET & START
30FA	Console Busy	Fix console

9.0

## PROGRAM PATCH CARDS

All patch cards are produced in the following format.

AAAAA DDDD

..... . . . .

. . . . . . . .

. . . . . . . .

. . . . . . . .

. . . . . . . .

. . . . . . . .

. . . . . . . . Data Value to patch

. . . . . . . . Single Space

. . . . . . . . Address to patch

. . . . . . . . Channel 12 punch in Col. 1.

These cards are to be inserted immediately prior to the  
last punched card of the program.



## OPTIONAL FUNCTIONS

10.0 FUNCTION 1 Enter /41XX

Where XX = the decimal number of the desired routine. When a value other than zero is entered in this function, the routine selected will be the only one run (except "Quick Initialize" which auto zeros switch 1) until another entry is made to switch one of this program.

10.1 Entering a zero into this switch (/4100) will allow the function test to continue with its normal sequence. It will not restart the program from routine one unless /4101 is first entered. Note that all routine ID's are referenced, entered and displayed (XR4) in decimal (BCD).

11.0 FUNCTION 2 Enter /81XX  
Following is a table which fully describes entries available through function switch 2. These entries are made by setting the console switches to /81XX where 'XX' corresponds to bits 8-15 in the table below.

BITS:	8	9	10	11	12	13	14	15	=	:
	0	0	1	X	M	N	N	N	=	DRIVE No.
	0	1	0	N	N	N	N	N	=	AREA CODE
	0	1	1	X	N	N	N	N	=	PGM. ILSW
	1	0	0	X	N	N	N	N	=	END ILSW
	1	0	1	N	N	N	N	N	=	"GROUP"
	1	1	0	X	X	X	X	X	=	S2. UNHOLD
	1	1	1	X	X	N	N	N	=	LEVEL

X = "DON'T CARE"

N = VALUE ENTERED IN BINARY

**M = SPECIAL MODIFIER:**

11.1 The first value "DRIVE NUMBER" is a mandatory entry as described earlier. Making this a mandatory selection makes it less likely to write random values on a system disc pack. However, if bit twelve (enter /8128) is turned on, the function will default to run on the lowest-numbered drive connected to the LDA (and ready and not reserved).



11.2 All other entries made through this function switch cause a "holding" condition to occur. The program assumes that if any one of the group including Area Code, ILSW bit, Group or Level are changed, then it may be required to change at least one other entry. Therefore the program issues a message:

"HOLDING -- AWAIT FURTHER INSTRUCTIONS"

--the operator may now enter any other entries required. To release the holding situation, enter /81C0. The program should now proceed with normal operation. If this does not occur, press "IMMEDIATE STOP", "RESET" followed by entering /01C0 and pressing "INTERRUPT REQUEST".

Defaults are set as follows:

AREA	11	/B
GROUP	0	/0
ILSW OP - END	14	/E
ILSW PROGRAMMED	13	/D

If a system runs with the defaults above there is no need to use this switch function.

12.0 FUNCTION 3

Enter /C1XX

This function switch allows the operator several immediate commands designed to facilitate tracking down errors and using the LDAFT on drives which have characteristics other than those automatically chosen by the function test.

12.1 The LDAFT may be shipped with "patch cards" which set default(s) to the desired customer configuration. Otherwise, the user may use function three or his/her own patch cards.

12.2 The function test assumes that a drive connected to the LDA will have either 815 or 822 tracks, 16 or 24 sectors and 19 or 5 surfaces. Based upon the state of sense word one bits "Nineteen surface ID" and "Twenty-Four Sector Tracks" the test chooses the appropriate constants to use for the operation of the test. If any manual selections are made to any of these constants all automatic selection is bypassed from that point on for that particular constant. Manual selection of nineteen / five surfaces is not supported since the "Nineteen surface ID" status comes directly from the drive.



Defaults are normally set as follows:

SECTORS : 16

CYLINDERS : 815

HEADS : 19/5 Set automatically by PGM

Standard OP Area: Cylinder 806; Head MAX (1326)  
(Head) 19 or 5; Sector 00.

<sup>1</sup> See section 9.0 "PATCH CARDS"

FUNCTION THREE OPERATIONS FOLLOW:

12.3 RESET ENTRY Enter /C100  
This Function resets any previous entry made. This is normally done, however, upon excution of completion of any function three operation.

12.4 SET SECTORS Enter /C101-/C102  
This over rides the automatic setting of this function via sense word one and is normally not required for /C101 sectors = 16 (Default), for /C102 Sectors = 24.

12.5 SET CYLINDER Enter /C103 through /C106  
This function is also normally automatic as above. For /C103 Cylinder = 815 (Default); /C104 Cylinder = 822; /C105 Cylinder = 411; /C106 Cylinder = 405  
Set Cylinder/Sector Defaults Enter /C107  
This function fixes the defaults shown in the above 2 paragraphs.

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(Function 3 cont.)

## 12. 6 HOLD FUNCTION /C108 - /C109

These two commands turn on and off the "HOLD" condition of the LDAFT respectively. When the LDAFT is in this holding condition, no routines are functional. We simply overlap through the monitor and wait for function switch entries which may be processed at this time. As soon as the operator has finished entering values in the function switches he/she may enter /C109 to resume normal operation. One may also restart the program at this point.

## 12. 7 DIAGNOSTIC SENSE FUNCTION /C10A - /C10B - /C10C

A diagnostic sense is a sense of the entire 256 bytes or 128 words of LDA scratch pad memory, as stated, for diagnostic purposes. If this switch is turned on (/C10A), thereafter any read or write which completes with a hard or soft error will cause a diagnostic sense to occur immediately following itself. When the sense has completed and been printed, the program will come to a /300D wait ("D" for "DIAGNOSTIC")

-For the operator to examine the many values thus given. Press "START" to continue. /C10C does an immediate diagnostic sense.

## 12. 8 PRINT ANY MESSAGE /C10D - /C1FF

This causes to be printed any message of the program's 190 odd messages, to test the printing function of the software. After entering /C10D, enter /C1XX where XX = the message number in HEX. Please refer to the last 21 pages of the program listing to refer to messages. The only message of normal interest to the user would be /38 -- "LAST DSW:". Enter /C10D followed by /C138 and then the last DSW from the LDA will actually be logged.

To release this function enter /C1FF

12. 9 TERMINATE THE CURRENT ROUTINE Enter /C10E  
 The meaning of this function is self-evident. Certain routines are long and boring. If this is the way you feel AND you have already fully tested that function or are tired of watching continuous error printouts, use it. Please note: the following routines cannot be terminated:

Routine	05	Select/Deselect Drive
	17	Alternate Sector Test
	21	Diagnostic Write Test
	25	Data Compare Test
	26	No-Sync Test
	28	Ecc Test
	29	Full Mem R/W Test
	32	Quick Initialize

This is because these routines might leave the program or disc pack in an unusable condition if terminated. When a routine is terminated with this function the next routine in sequence will start.

12. 10 EXECUTE LAST R/W IN ERROR

This program stores all R/W XIO command chains which terminate in error (hard or soft). Only the last one, however, is kept. Therefore if one wants to execute it and scope a particular circuit point while it loops one may do this. Note that if /0104 (bypass log routine) is also entered, the loop may be tighter. If DSW errors are occurring during this loop only DSW bits in error are logged such as: "DATA OVERRUN".

To exit this enter: /C109 and press interrupt request.

12. 11 RESET THE LDA Enter /C110

This command will execute the following immediate XIO's to the LDA:

HALT LDA  
 RESET OP-END INTERRUPT  
 RESET PROGRAMMED INTERRUPT  
 UNMASK LDA INTERRUPTS  
 -and clear all the interrupt flags

12. 12 CLEAR THE SUMMARY Enter /C111

This function immediately clears the summary (normally done automatically at program start) at any time during program operation - For example, to see if any errors occur after a certain point in time.

12. 13 PRINT A RANDOM NUMBER Enter /C112  
 This switch will print a random number and hold, printing a new random number each time the function is entered. This function is for those who like random numbers or to verify the operation of the random generator.  
 To exit enter /C109.

12. 14 SET STANDARD CYLINDER/HEAD/  
 SECTOR OPERATING AREA Enter /C113  
 Set the default Cylinder /326 Head /12 or 4 (Maximum head value) and Sector Zero.

12. 15 PRINT THE SUMMARY Enter /C114  
 Prints the summary anytime the program is active and continues.

12. 16 TERMINATE THE PROGRAM Enter /C115  
 This function terminates the program and prints a summary. This function, if entered during a routine which cannot be terminated under /C10E section 8.6, will not be executed until that routine has normally terminated.

12. 17 INHIBIT/ENABLE ENDING SUMMARY Enter /C118 - /C119  
 These entries respectively inhibit or enable ending summaries to be printed. The default is enable.

12. 18 INHIBIT/ENABLE WRITE TO OTHER  
 THAN STANDARD CYLINDER Enter /C118 - /C119  
 This is a mandatory entry. If /C119 is entered then writes may be done to other than the cylinder selected as standard (default /326) and the diagnostic may operate uninhibited!  
 If /C118 is entered then routine 29 will not operate with 80 Megabyte drives (64K words > 1 cylinder's worth), routine 30 will not write and the Quick Initialize will not operate, in case accidentally selected.

12. 19 SET DEFAULT CYCLE STEAL DEALY Enter /812X where X =  
 cycle steal delay  
 The cycle steal delay default is set at #1 for 80 and 300 Megabyte drives and #2 for 200 Megabyte drives. This function will fix this default at the value entered from # - /F.



12.20 SET STANDARD OP AREA      Enter /C1XX with bits 8 and/or 9 on  
This function is desirable when one wants either to  
exercise a particular area on a pack or to restrict the  
operation of the diagnostic to a cylinder other than the  
standard default: Cylinder /326 Head /12 or /04  
and Sector /00. Entries are made as follows:

Bit 9 alone on:

Bits 11-15 contain STD head value

Bit 8 alone on:

Bits 12-15 have LO order STD cylinder value

Bit 8 and 9 on:

Bits 10-15 have HI order STD cylinder value

Bit 8 and 10 on (not 9):

Bits 11-15 have STD sector value

13.0

TEST ROUTINE DESCRIPTIONS

13.1

Routine One: NO/OP Test Interrupt

1. Issue a No-Operation with programmed interrupt.
2. Insure that both OP-END and PROGRAMMED interrupt returned.

13.2

Routine Two: NO-OP/Sense DSW

1. Issue a No-Operation and Sense.
2. Insure that interrupt and DSW returned from device.

13.3

Routine Three: MASK/UNMASK

1. Mask the LDA.
2. Issue a NO-OP and Sense.
3. Wait a sufficient period to complete operation.
4. Insure no interrupts returned.
5. Unmask the LDA.
6. Insure interrupt returned.
7. Repeat steps one through six, ten times.

13.4

Routine Four: Diagnostic Sense

1. Clear the Sense Buffer.
2. Issue the Diagnostic Sense.
3. Test for Non-Zero in "LADS".
4. If loop not on, display contents.
5. If contents displayed, wait 10 seconds before proceeding to allow operator to view display.

13.5

Routine Five: Select/Deselect Drive

1. Select Drive Zero.
2. Sense the LDA.
3. If the drive is ready and not reserved, put its ID number in a table.
4. Increment the drive number and repeat steps 1, 2, 3 until drive number = 8.
5. If more than one table entry, display contents of table on console.
6. If no entries, log "NO DRIVE IS CONNECTED TO THE LDA".



7. If default drive is selected (/8128 entered) set lowest numbered drive in table as operational drive.
8. Set up all command tables to select drive chosen.
9. Select and deselect the drive and insure that no drive is selected.

13.6 Routine Six: Set Head Test

1. Issue a set head to all heads available.
2. Issue no errors.
3. Randomly select heads 100 times (log any errors).

13.7 Routine Seven: Sequential Seek Routine

1. Seek to cylinder zero.
2. Increment the seek value until at the last available cylinder seeking to the cylinder each time.
3. Decrement cylinder value.
4. Seek to cylinder indicated and repeat step 3 until at cylinder zero (log any errors).

13.8 Routine Eight: MAXIMUM/MINIMUM Seek In and Out

1. Set two values A and B:  
A =  $\emptyset$     B = MAXIMUM CYLINDER ADDRESS.
2. Seek to cylinder A.
3. Seek to cylinder B.
4. Increment A.  
Decrement B.
5. Repeat 2,3 and 4 until B= $\emptyset$ .
6. Increment B.  
Decrement A.
7. Seek to A.
8. Seek to B.
9. Repeat 6,7 and 8 until A =  $\emptyset$ .



13.9      Routine 9: Absolute Random Seek  
1. Create a pseudo-random number.  
2. Truncate the value to the cylinder maxima.  
3. Seek to the cylinder specified.  
4. Repeat steps 1,2, and 3 1100 times.

13.10     Routine 10: Unavailable Cylinder Test  
1. Select a value greater than the cylinder maxima.  
2. Issue a seek to it.  
3. Insure that proper errors logged in DSW.  
4. Repeat steps 1,2, and 3 incrementing the cylinder value each time 100 times.

13.11     Routine 11: Read Sector ID Test  
1. Read the standard area ID.  
2. Verify its correctness.  
3. Read an ID from a table of Cylinder/Head/Sector values which represent all possible bits in either state (on/off).  
4. Verify each value's correctness in the ID read.  
5. Increment the table pointer and repeat 3 & 4 until all table ID's have been read and verified.  
6. Read a randomly selected ID.  
7. Verify its correctness.  
8. Repeat 6 & 7 127 times.

13.12     Routine 12: WRITE/READ/VERIFY ID Field  
1. First read the ID starting with the first sector of the "standard-area" cylinder.  
2. Verify the correctness of this ID and if it is flagged defective.  
3. Initialize-Write the correct ID.  
4. Read the ID and verify its correctness.  
5. Increment the sector address and repeat steps one through five until the entire cylinder has been initialized. (LOGGING ANY DISCREPANCIES OR DEFECTIVES ENCOUNTERED)

13.13 Routine 13: Write Various Data Fields

1. Construct an Eight-Sector Data Field from a table constant.
2. Write the eight-sector field to the disc.
3. Test for errors.
4. Increment to the next data-field constant in the table and repeat steps 1-4 until the table is exhausted.
5. Construct a random field.
6. Repeat steps 2,3 and 5 ten times.

13.14 Routine 14: Read Increasing Word Count to Eight Sectors

1. Write an eight-sector random field to the disc at the "Standard Area".
2. Clear an Eight Sector Field.
3. Do a read at the standard operation area starting with a word count of one.
4. Verify that the correct count and only it were entered into the buffer.
5. Increment the word count.
6. Repeat steps three through five until the entire eight sector field has been read in one fell swoop.

13.15 Routine 15: Write/Read/Compare Random Data

1. Set up a random field of approximately 3.5 sectors, word count = /47F.
2. Write that field to the disc starting with the first sector and head of the standard cylinder.
3. Read the same field back to a separate buffer.
4. Compare the entire contents if each field (to the end or until a compare-error is encountered).
5. Increment the starting disc address.
6. Test for the end of the cylinder.
7. Repeat steps one through six until the procedure has been accomplished starting at each of the cylinder's sector-heads. (Except the last three)

13.16 Routine 16: Suppress Transfer

1. Write a random field to the disc of eight sectors.
2. Clear the entire buffer.
3. Set up a suppress-transfer command chain.
4. Perform a suppress transfer read "TO THE BUFFER".
5. Ensure that no errors occurred and that no transfer was made.
6. Repeat steps one through five, ten times.

13.17 Routine 17: Alternate Sector/Track Test

1. Read Sector ID's in the alternate area (starting with the second cylinder in the "ALTERNATE" area).
2. Find a complete track (16 or 24 sectors, depending on drive) not assigned as alternate.
3. Write ID's starting at the first sector-head of the standard-op cylinder assigning the first area of this cylinder as defective to the alternate track found above.
4. Do an eight-sector read of that area.
5. Ensure that the proper DSW and LADS (Last-Accessed Defective Sector) are present by doing a diagnostic sense with the read.
6. Repeat 4 and 5 above eight times.
7. Do an eight-sector write to the assigned defective track.
8. Repeat steps 5 and 7 for the Write eight times.
9. Un-assign the standard operation area's first track as defective.
10. Assign its first sector as defective.
11. Assign the first sector of the track previously found as its alternate.
12. Perform a normal eight-sector READ starting at that assigned defective sector.
13. Again repeat steps 12 and 5, eight times.
14. Perform a normal eight-sector WRITE starting at the assigned defective sector.
15. Repeat steps 14 and 5, eight times.
16. Re-initialize both the primary and alternate areas used in the above tests.
17. Repeat steps 1-16 two times.

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13.18 Routine 18: Unavailable Head Test

1. Set up an XIO "Set Head" to a head address greater than the Head Maxima for the selected drive.
2. Execute the erroneous operation.
3. Test for proper errors in the DSW.
4. Increment the head value.
5. Repeat steps two through four until the maximum value encompassed by the drive's Head Register has been used in an XIO.
6. Exit the test if proper DSW errors are not encountered.

13.19 Routine 19: Unavailable Sector Test

1. Set up an XIO Read to a sector whose address is one greater than the maxima for the drive selected.
2. Execute the erroneous operation.
3. Test for proper DSW error.
4. Repeat steps two and three, ten times.
5. Exit the test if proper errors are not found in the DSW.

13.20 Routine 20: Diagnostic Read Test

1. Perform a setup of a random data field in the write buffer of one sector, and write it to the disc.
2. Clear the read buffer.
3. Perform a diagnostic read to the read buffer.
4. Find the ID sync and its shift-justification factor.
5. Shift-justify the ID field and its ECC putting them at the beginning of the read buffer.
6. Find the data-sync and its shift-justification factor.
7. Shift-justify the data field and its ECC and put it just after the ID field justly justified.
8. Compare the ID read with that requested.
9. Compare the data read with that written.
10. Repeat steps two through nine, twenty-five times.



13.21      Routine 21: Diagnostic Write Test

1. Perform the entire protocol described in 9.20.1 through 9.20.9 previously (Do a diagnostic read).
2. Use the data gleened from the diagnostic read to set up for the diagnostic write. (ECC's)
3. Perform the diagnostic write.
4. Read the data so written.
5. Repeat the entire operation steps one through four, ten times.

13.22      Routine 22: Read ID and Data

1. Read the ID and data beginning at the first sector-head of the standard operation cylinder.
2. Increment the sector-head value.
3. Repeat steps one and two until the entire cylinder has been tested.
4. Fetch a random address.
5. Read the ID and data at that random Cylinder/Head/Sector.
6. Repeat steps four and five, twenty-five times.

13.23      Routine 23: Offset Forward/Reverse (Seek) Test

1. Set up an offset Forward read command.
2. Perform the command.
3. Test for lack of seek error.
4. Setup an offset Reverse read command.
5. Perform the command.
6. Test for lack of seek error.
7. Repeat steps one through six, ten times.

13.24      Routine 24: "Alternate" Command Buffer Test

1. Chain two command buffers together with an "alternate" buffer command.
2. Perform the dual operation.
3. Test DSW word three for a proper "Last Command Address".
4. Repeat steps two and three fifty times for fun.



13.25      Routine 25: Data Compare Error Test

1. Read the standard area sector ID.
2. Test the value for accuracy.
3. Modify the value to be incorrect.
4. Write the modified value back to the standard area.
5. Perform a standard read at the standard area in the standard manner.
6. Test for the proper errors in the DSW.
7. Correct the ID by re-writing it.
8. Read the ID without error.
9. Repeat steps one through eight, twenty-five times.

13.26      Routine 26: No-Sync Error Test

1. Perform a complete diagnostic read protocol as defined in 9.20.1 through 9.20.9.
2. Test for the requested ID values.
3. Set up a diagnostic write buffer.
4. Ruin the data sync right within the buffer.
5. Diagnostically write the ruinous sync et cetera to the specified area.
6. Perform a read of the no-synced standard area.
7. Test for the errors expected in the DSW.
8. Diagnostically write a properly synced field to the standard area.
9. Perform a read expecting no errors.
10. Repeat steps one through nine, ten times.

13.27      Routine 27: Read-Only Sector Test

1. Set up an XIO initialize-write to create a read-only-sector at the standard-op area.
2. Perform the operation.
3. Read the sector in question with no errors.
4. Perform an erroneous write at this time.
5. Test for the proper errors.
6. Repeat steps three through five, ten times.



## 13.28 Routine 28: ECC Test

1. Perform diagnostic read protocol 9.20.1 through 9.20.9.
2. Extract the ECC for the ID field.
3. Set up six diagnostic write fields with the following data: (in the eight-sector buffer)
  - 3.1 Forward Positive Count
  - 3.2 Reverse Negative Count
  - 3.3 Zero's
  - 3.4 /FFFF's
  - 3.5 /5555's
  - 3.6 /AAAA's
4. Set up to start operating at a zero bit displacement from the start of the first data field.
5. Mask an error from an error table into the data field currently in use at the displacement currently set (starting with the first error-mask in the table at the beginning of the datafield).
6. Perform the diagnostic write to create the future ECC error.
7. Read the area just erroneously written.
8. Test for the proper DSW.
9. Re-modify the diagnostic write buffer to be correct.
10. Compare the data read with the corrected data written.
11. Increment the error bit displacement by a fixed value.
12. Repeat steps five through eleven until the bit displacement equals the number of bits per sector.
13. Zero the displacement and increment to the next data field.
14. Repeat steps five through thirteen until all data fields have been tested thus.
15. Initialize back to the first data field.
16. Increment to the next error-mask in the table.
17. Repeat steps five through sixteen until the error-table is totally exhausted.
18. Correct the ECC error by performing a standard write.

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13.29 Routine 29: WRITE/READ of 64K

1. Set up execution tables.
2. Open aux core.
3. Find memory size to put in the XIO tables.
4. Save and randomize all high order-HEX-digit-zero-boundry locations throughout memory.
5. See if one cylinder is sufficient to write the entire memory to disc, if not change the cylinder value.
6. If cylinder change required, see if we are operating on a system pack, if so exit routine.
7. Write the entire memory to the disc.
8. Zero the high-order HEX digit zero boundry locations throughout memory.
9. Read the entire memory back from the disc.
10. Test the locations previously randomized and zeroed for the correct values.
11. Reinstate the original memory locations.
12. Repeat steps one through eleven, ten times.
13. Close aux core.

13.30 Routine 30: READ/WRITE/SEEK/RANDOM

1. Set up an eight-sector random data buffer.
2. Create random values for cylinder head and sector.
3. Insert the random values into the read and write command table, truncated to the appropriate address maximas.
4. If a system pack, bypass step five.
5. Write the random data to the random area.
6. Read the random data from the random area.
7. Repeat steps one through six, one-hundred times.



OPTIONAL ROUTINES:

13.31 Routine 31: Overflow Sector/Head/Cylinder

1. Set up the XIO buffer starting values:  
Cylinder =  $\emptyset$  Head =  $\emptyset$  Sector = Max-2.
2. Perform a four sector read with a diagnostic sense.
3. Test the SCTAD for the overflow values expected for the last sector operated on. If Head = Head Maxima, test for Cylinder = Cylinder +1.
4. Increment the head address in the XIO table.
5. Repeat steps two through five until all cylinders in the data area have been tested.

13.32 Routine 32: Quick Initialize Routine

1. If a system pack, exit.
2. Build one large XIO for initializing an entire cylinder with a single host command.
3. Initialize the cylinder.
4. If no problems, increment the cylinder value throughout the entire command chain.
5. Repeat steps 3 and 4 until all cylinders have been initialized.
6. Log the routine termina.

13.33 Routine 33: Read all ID's and Data

1. Create a full cylinder XIO buffer as with Routine 32.
2. Read the entire cylinder.
3. If no problems, increment the cylinder value throughout the command buffer.
4. Repeat steps two and three for all cylinders.



LDA STATUS WORDS

WORD ONE  
BIT

0	OPERATION ERROR ABORT
1	SUCCESSFUL OPERATION END
2	NOT READY
3	INVALID COMMAND
4	NINETEEN SURFACE ID
5	DATA ERROR
6	NON CORRECTABLE DATA ERROR
7	DRIVE SEEK ERROR
8	WRITE PROTECTED
9	UNAVAILABLE CYLINDER ADDRESS
10	UNAVAILABLE HEAD ADDRESS
11	UNAVAILABLE SECTOR ADDRESS
12	DRIVE FAULT
13	INVALID COMMAND SEQUENCE
14	TRANSFER LOCKOUT
15	TWENTY-FOUR SECTOR TRACKS

### OPERATION ERROR ABORT (WORD 1 BIT 0)

This bit is the logical "or" of all abnormal conditions.

If this bit is on, one or more of the following conditions will also be flagged.

- DATA ERROR
- NON CORRECTABLE DATA ERROR
- WRITE PROTECTED ERROR
- DRIVE SEEK ERROR
- UNAVAILABLE CYLINDER ADDRESS
- UNAVAILABLE HEAD ADDRESS
- UNAVAILABLE SECTOR ADDRESS
- READ/WRITE FAULT
- UNAVAILABLE DRIVE
- DRIVE RESERVED

The memory address of the command for which the error bit was set is provided in an additional status word.

If an error is still indicated at the end of the automatic error retry then the LDA will look for a sense command at the end of a command chain. The sense command will be executed if found and then an interrupt will be generated. If there is no sense command then the interrupt will be generated immediately.

### SUCCESSFUL OPERATION END (WORD 1 BIT 1)

Indicates that all commands fetched as a result of the last START XIO were executed without any abnormal conditions occurring.

### NOT READY (WORD 1 BIT 2)

Attached drive cannot be accessed.



WRITE PROTECTED (WORD 1 BIT 8)

Drive cannot be written to. Is turned on with error when read only sector is attempted to be written

NINETEEN SURFACE DR. (WORD 1 BIT 4)

Indicates selected drive has 19 surfaces instead of 5.

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LDA STATUS WORDS

WORD TWO  
BIT

0	UNAVAILABLE DRIVE
1	MULTIPLE DRIVES SELECTED
2	DRIVE RESERVED
3	NO DRIVE SELECT ENABLED
4	MSB
5	
6	CURRENTLY SELECTED DRIVE
7	LSB
8	
9	RESERVED
10	
11	MSB
12	
13	NEXT AVAILABLE SECTOR
14	
15	LSB

## LDA STATUS WORDS

### WORD THREE

Memory address of last command fetched that was not a sense or transfer command buffer command.

If there was no error the address will be that of a read, write, or control command.

If there was an error the address will be that of the command for which the error occurred.

Will be all ones following DC reset

### WORD FOUR

Will provide adapter control program version number in bits 0 thru 7, and modification number in bits 8 thru 15.

Example: first controller will be version 1 mod 0 or /0100

### WORD FIVE

WORD FIVE and beyond will be used for diagnostic status.

LDA STATUS WORDS

WORD FIVE

DIAGNOSTIC STATUS

Bit

0	Drive Fault
1	No Sync
2	ECC Error
3	Data Compare Error
4	Offset Reverse
5	Offset Forward
6	Retard Data Window
7	Advance Data Window
8	Sector Overrun
9	Data Overrun
10	Defective Sector
11	Defective Track
12	Sector ID OK
13	Primary Sector ID Bad
14	Re-Zero
15	Offset Error

LDA STATUS WORDS

WORD SIX

DIAGNOSTIC STATUS

Bit

0	Read ID Timeout
1	Successful Error Correction
2	Invalid Word Count
3	Alternate Sector
4	Drive Seek Error
5	Error Protrudes Data/ECC Field
6	Poly. Reg. 3 cannot equal Poly. Reg. 0
7	Poly. Reg. 2 cannot equal Poly. Reg. 0
8	Poly. Reg. 1 cannot equal Poly. Reg. 0
9	Burst Greater Than 11 Bits
10	Non Error Bits of Mask Protrude Data Field
11	Burst in ECC Field
12	Burst Overlaps Data/ECC Boundary
13	Burst Overlaps Word Boundary in Data
14	Burst Contained in Single Data Word

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## LDA STATUS WORDS

### WORD SEVEN

Host memory Address of First Word in Error

### WORD EIGHT

Bit Mask to Correct Error (if error burst crossed word boundary then bit mask is folded around into a single word).

## CONTENTS OF THE LDAFT PROGRAM

	Page
TITLE BLOCK	1
SWØ AND ERLCK	2
MLSCF	3
INITIALIZE, START AND OVERLAP CONTROL	4
ROUTINE CONTROLLER	6
ROUTINE CONTROLLER TABLES	14
PROGRAM OPERATIONAL ROUTINES (XEQ)	16
DEVICE STATUS CHECK SUBROUTINES	23
PROGRAM SWITCH TESTS	32
DEVICE STATUS TABLES	48
OPERATIONAL TABLES	50
SUMMARY TABLE	53
XIO TABLE	55
MESSAGE TABLE	57
ROUTINE	
ONE	NO OP INTERRUPT
TWO	NO OP SENSE
THREE	MASK/UNMASK
FOUR	DIAGNOSTIC SENSE
FIVE	SELECT DRIVE
SIX	SET HEAD
SEVEN	SEQUENTIAL SEEK
EIGHT	MAX/MIN SEEK
NINE	RANDOM SEEK
TEN	UNAVAILABLE CYLINDER
ELEVEN	READ SECTOR ID'S
TWELVE	INITIALIZE WRITE
THIRTEEN	WRITE VARIOUS DATA
FOURTEEN	READ INCREASING WORD COUNT
FIFTEEN	WRITE/READ/COMPARE/RANDOM
SIXTEEN	ALTERNATE SECTOR/TRACK
SEVENTEEN	SUPPRESS TRANSFER
EIGHTEEN	UNAVAILABLE HEAD
NINETEEN	UNAVAILABLE SECTOR
TWENTY	DIAGNOSTIC READ
TWENTY-ONE	DIAGNOSTIC WRITE
TWENTY-TWO	READ ID & DATA
TWENTY-THREE	OFF SET
TWENTY-FOUR	"ALTERNATE" COMMAND
TWENTY-FIVE	DATA COMPARE



TWENTY-SIX	NO-SYNC	134
TWENTY-SEVEN	READ ONLY SECTOR	139
TWENTY-EIGHT	ECC	142
TWENTY-NINE	READ/WRITE 64K	160
THIRTY	READ/WRITE/SEEK/RANDOM	
THIRTY-ONE	OVERFLOW SECTOR/HEAD/CYLINDER	166
THIRTY-TWO	QUICK INITIALIZE	172
THIRTY-THREE	READ ALL ID'S AND DATA	177
<b>GENERAL SUBROUTINES</b>		182
<b>MESSAGE LOGGING ROUTINE</b>		203
<b>ALPHA MESSAGE FIELDS</b>		211
<b>SYMBOL TABLE</b>		232
<b>CROSS REFERENCE</b>		236
<b>SYMBOL/ERROR SUMMARY</b>		258

  
CHI